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Electronic Business

FOR MANAGEMENT IN ELECTRONICS, COMPUTER & SYSTEMS COMPANIES — WORLDWIDE

NOVEMBER 13, 1989

INTEL AND IBM SHARE THEIR MULTIMEDIA VISION

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Five years from now, the electronics industry and its customers will look back at 1989 as the year in which a brave new world of personal computing began to congeal. This world — to be made possible by a technology known as Digital Video Interactive, or DVI — will be populated by multimedia computers that routinely mix text, graphics, still images and full-motion video. The vision belongs to Intel and the semiconductor company has joined with IBM and software kings Microsoft and Lotus Development to make it happen.

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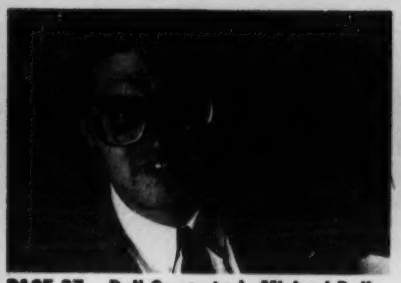
Cover photograph: Jonathan Levine



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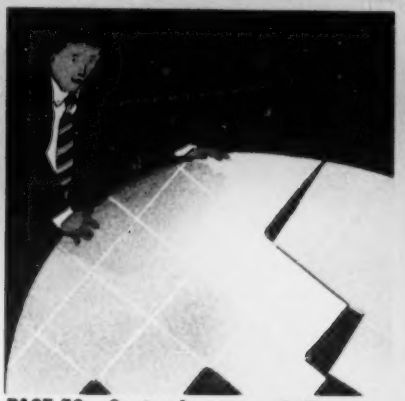

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EDITORIAL STAFF

Publisher: Frank J. Burge

Editor: Jeffrey Bairstow

Managing Editor: Roger C. Plant

Senior Editors: Linda Stallmann (Financial), Bruce C. P. Rayner, Valerie Rice, Rick Whiting, Barbara N. Berkman

Associate Editors: Anthony E. Greene, Michael R. Leibowitz

Assistant Editors: John McCreadie, Xiong Xiaoge

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Consulting Editors: Alberto Socolovsky, Allen Furst

Production Editor: Karen J. Covey

Editorial Assistant: Jean O'Brien

ART STAFF

Art Director: Norm Graf

Associate Art Director: Carla Aguilar Leeder

EDITORIAL OFFICES

Boston: Cahners Building
275 Washington Street, Newton, Mass. 02158
(617) 964-3030 Telex: 94 0573 CPC BSN
Fax: (617) 558-4327 MCI: EBBOS

Washington, D.C.: Anthony E. Greene
1333 F Street, N.W., Suite 720
Washington, D.C. 20004 (202) 628-2773

San Jose, Calif.: Valerie Rice (Bureau Manager), John McCreadie
Sherman Building, 3031 Tisch Way, Suite 100,
San Jose, Calif. 95128 (408) 296-0868

Irvine, Calif.: Bruce C. P. Rayner
18818 Teller Avenue, Suite 170
Irvine, Calif. 92715 (714) 851-9422

Northwest: Paula Doe
5011 133rd Place SE
Bellevue, Wash. 98006 (206) 641-0903

London: Barbara N. Berkman
27 Paul Street
London EC2A4JU England 011-44-1-628-7030
Fax: 011-44-1-628-5984

PRODUCTION

VP Production: Wayne Hulitzky

Director of Production/Manufacturing: John R. Sanders

Production Supervisor: Andrew A. Jantz

Production Manager: Betsy Harkins; (617) 964-3030

CIRCULATION

Circulation Manager: Ann Ward
44 Cook Street, Denver, Colo. 80206
(303) 388-4511

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Getting it right

Credibility with readers is probably the biggest asset any publication has going for it. This is especially true for us at ELECTRONIC BUSINESS because we are a magazine for top management in the high-tech industry. While any publication worth its salt always is duty-bound to get names and titles right, our need for accuracy is far greater because of the technical nature of many of our stories. And because our readers are the leaders in some of the most influential companies in the world, we can't afford to get our facts wrong. We can't afford to lose our credibility and lose our readers.

All of this leads to one of the subjects of this column, Michelle Doses, our research editor, whose job it is to verify the facts in the stories we publish. In checking facts, Michelle goes through a painstaking process in which she telephones each source in a particular story to verify nonquoted information. Michelle also has at her disposal numerous books, directories and reports with which to check information.

Michelle Doses, research editor

Jean O'Brien, editorial assistant

We believe in the quality of our magazine, and fact-checking is just that extra yard to ensure accuracy.

We also introduce Michelle because she is one of our newer staff members. So if you're a source in an ELECTRONIC BUSINESS story, please expect Michelle to call you. And crucial to her job is that you return the call if she doesn't reach you right away.

Another new staff member to introduce is editorial assistant Jean O'Brien. Jean has the sort of role that keeps all of us at ELECTRONIC BUSINESS on track. She coordinates the office, pays the bills and orders the supplies we need. When you reach our main office number, more likely than not Jean's voice is the one you'll hear. She's able to answer almost any question or can refer you to the appropriate editor. Jean's a good person to get to know, too, because she has the most direct line to busy editor Jeff Bairstow.

MARVIN GREENE, section editor

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VBPA ABP

Intel and IBM share their multimedia vision

Backers of Digital Video Interactive technology say a new information medium — multimedia computing — is on the horizon. Routinely mixing text, graphics, still images and full-motion video, the technique is predicted to spawn new businesses, methods and markets

BY DWIGHT B. DAVIS

Five years from now, the electronics industry and its customers will look back at 1989 as the year in which a brave new world of personal computing began to congeal. This world will be populated by multimedia computers that routinely mix text, graphics, still images, and full-motion video. It will be made possible by a digital compression/decompression technology known as Digital Video Interactive, or DVI.

The above vision belongs to Intel Corp., which acquired the DVI technology from General Electric Co. in October 1988 for a reported $25 million. The semiconductor manufacturer is not alone in its view. Last March IBM signed an agreement with Intel to develop the technology further, and software kings Microsoft Corp. and Lotus Development Corp. are among other backers.

Representatives from all of these companies claim that by 1992 to 1995, the basic, "plain vanilla" personal computer sold will contain built-in multimedia capability. As such, they all view an early involvement in the technology's evolution as vital to their companies' future success in the personal computer marketplace.

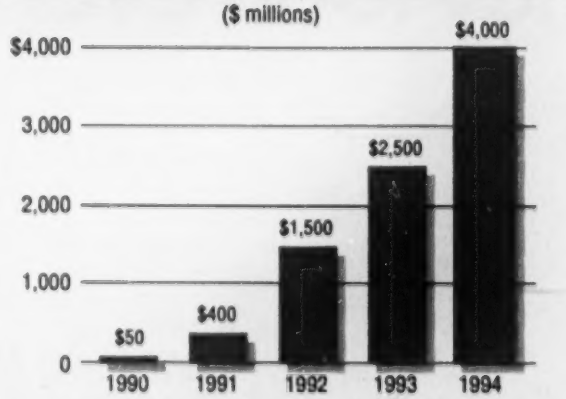
"DVI is really fundamental to Intel remaining the leader in workstation and PC architectures," according to Bob Brannon, general manager of Intel's Princeton Operation, Princeton, N.J., which has been established to nurture and commercialize DVI. The Princeton Operation started off by hiring 36 of the SRI/David Sarnoff Research Center staff that developed DVI, and has since expanded to approximately 100 people.

Beyond its use as an "enabling technology" for Intel to develop new computing architectures, "audio/video computing represents a huge opportunity, and one that is much bigger than we really understood initially," Brannon says. "It's conceivable that this operation will spawn a different set of businesses, technologies and markets that are beyond our stated mission of making components for multimedia PCs." Videophones and videoconferencing, for example, are two sectors that could benefit from DVI's digital compression/decompression techniques.

Concurring with this perspective is Pradeep Singh, group manager within the applications publishing arm of Microsoft's Multimedia Division, established June 1 in Redmond, Wash. "We perceive multimedia computing, or interactive multimedia, to be a new information medium that will be in the same league as print, audio cassette tapes and records, radio and television," according to Singh. "This will be a pervasive medium in people's lives, not just in the personal computing realm."

Still, the personal computer realm is where the early DVI development will occur, and its potential as a submarket is far from trivial. Diversified Data Resources Inc. of Falls Church, Va., estimates that 1 million to 2 million multimedia personal computers will be sold in 1994, representing a value of about $4 billion.

Digital video for personal computers



Source: Diversified Data Resources Inc.

Intel, IBM and other DVI backers expect to establish it as a de facto industry standard, rather than to shepherd it through the long and complex ratification process required by standards-setting bodies such as the American National Standards Institute Inc. and the International Standards Organization. "We will publish the interfaces and will give people technological books and make it an open standard," says Brannon.

This approach is sup-

Bob Brannon, left, general manager of Intel's Princeton Operation, and Satish Gupta, IBM's manager of multimedia products, predict that Digital Video Interactive technology will be synonymous with multimedia computing

Jonathan Levine

ported by Satish Gupta, manager of mixed-media products at IBM in Somers, N.Y., who says the electronics giant hopes that other PC manufacturers, as well as its marketplace competitors, will unite behind DVI. "We expect it to be an open industry-wide platform and not proprietary to IBM," he says.

Gupta and Brannon acknowledge that other piecemeal standards, say in audio or graphics, may become established over time, but Brannon says it will be Intel's policy to incorporate any such proven standards into the overall DVI umbrella. He notes, for example, that Intel has announced its plans to support Microsoft's CD-ROM/XA audio techniques within DVI, along with DVI's original audio scheme.

The only other comprehensive multimedia standard to emerge is Compact Disc-Interactive (CD-I), announced by N.V. Philips GL of The Netherlands and Japan's Sony Corp. a year prior to DVI's March 1987 public debut (both at the annual Microsoft Conference on CD-ROM).

Because both CD-I and DVI offer broad CD-based approaches to achieve multimedia, the two are often compared. But the DVI camp believes CD-I's system architecture and target market mean CD-I will rarely compete with the processor-independent, business-oriented DVI. CD-I's architecture is a closed-box system designed to hook into television sets or other monitors, primarily for the home consumer.

Regardless of the competition, many observers expect DVI to dominate in the personal computer marketplace because of the technology's sophistication and its early torch bearers. Noting that even IBM can't guarantee

Who'll be king of multimedia applications? CD-I or DVI?

The first digital multimedia applications will target business and professional markets, but the vast home consumer marketplace is never far from the minds of most industry participants. The purchasing dynamics of the home market are more problematic than those of business, however. In addition, the consumer sphere may be the main battleground where the two major multimedia standards — Digital Video Interactive (DVI) and Compact Disc-Interactive (CD-I) — eventually face off.

Of the two standards, CD-I always has been promulgated primarily as a home-oriented technology. Developed by N.V. Philips GL and introduced jointly by Philips and Sony Corp. in March 1986, the CD-I standard specifies a 68000-based, closed-system box designed to connect to a home television or some other monitor, much like a video cassette recorder.

In May of this year, Matsushita Electric Industrial Co. Ltd. of Japan joined the CD-I team, and plans to sell CD-I systems in the United States under its Panasonic brand name. The major developer for CD-I applications is American Interactive Media (AIM), a venture established jointly by Philips and the PolyGram recording company.

The CD-I backers plan a six-month marketing blitz followed by the simultaneous release of hardware and software titles in late 1990 or early 1991, according to Emiel N. Petrone, senior vice president for marketing and public relations at AIM. Titles under development include children's programs, games, how-to instruction, music, and general entertainment subjects. "We focus exclusively on the home consumer," he says.

"A key advantage of CD-I over DVI is that CD-I requires no computer nor any computer background," Petrone maintains. In fact, a strategy of the CD-I marketers is to avoid mention of computers altogether.

Others, though, question both the assumption that consumers are gun-shy about computers as well as the CD-I approach of requiring users to buy a separate box to gain multimedia capability. "The perception that personal computers have had little success in the home is wrong," says Pradeep Singh, group manager within Microsoft Corp.'s Multimedia Division. "Approximately 20% of the homes in the United States already have computers."

Owners of home personal computers are more likely to look for multimedia on their computers as opposed to buying a separate system that links to their televisions, Singh argues, even if the CD-I boxes attain their initial target price of $1,000. He and others also expect the coming availability of multimedia personal computers to hasten dramatically the incursion of computers into the home.

A strategy of the CD-I marketers is to avoid mention of computers altogether

To some observers, the closed, separate-box CD-I configuration constitutes a fatal flaw. "There's no way they can sell a separate consumer product that people will buy above and beyond their home computer," says Linda Helgerson, president of consulting firm Diversified Data Resources Inc. "My bottom line is that CD-I will never, never make it."

Even more important than the issue of delivery vehicles may be the quality of the multimedia presentations themselves. Many doubt that consumers will buy a system that generates videos of lesser quality than standard television output, even if that system also plays standard audio CDs, displays sharp graphics and still images, and offers the ability to interact with the programs. By contrast, business and home computer users are expected to be impressed by the novel appearance of video images on their screens, regardless of the quality.

Even DVI, which offers full-screen, full-motion video, doesn't quite match television-quality output because of the data loss inherent in the technology's compression techniques. CD-I meanwhile, in what has proven a sore point in its match-up with DVI, can't even provide full-screen video; developers are now limited to filling a maximum of about 40% of the TV monitor with video motion pictures.

This summer, Philips addressed this limitation, announcing the ongoing development of a special-purpose decoder chip that will allow CD-I to support full-screen, full-motion video at "normal" resolutions. Like DVI, the enhanced CD-I will permit up to 72 minutes of full-screen video plus sound to be stored on a CD, Philips claims.

The new chip will be available in the 1990-91 time frame, and will reside in all CD-I consumer products, says Alex Korthals, director for marketing for laser-optics products at Philips Consumer Electronics. "Even with the video chip included, the consumer system price will still hold at $1,000," he says. Whether its compressed video output will match that of today's televisions — much less that of future high-definition TV — will have to wait to be seen.

Technology aside, Korthals says the main weakness of any DVI assault on the home market may be the nature of the computer and software companies themselves. "You need a big organization and a lot of experience to operate in the consumer market," he says, noting that Philips, Sony, and Matsushita have strong credentials in that regard.

Meanwhile, not content to remain confined to that market, Philips has announced a "professional" CD-I system due out by year-end. The system will consist of a disc player module and a multimedia controller module, and will sell for about $2,500. (An optional expansion module providing extra data storage capacity will also be offered.) □

DVI's success, Rob Lippincott, director of market development for Lotus' Information Services Group, Cambridge, Mass., still says, "If you had to put together the right cast of characters, Intel has done it."

Microsoft's Singh concurs, saying no credible competition to DVI yet exists. "We expect DVI to become so successful that it will become synonymous with multimedia computing," he predicts.

Market projections from Linda Helgerson, president of Diversified Data Resources Inc. and the editor and publisher of various optical storage technology newsletters published by sister company DDRI Inc., supports this optimism. She expects DVI quickly to garner almost 100% of the available personal computer multimedia market, and to hold its dominance for the foreseeable future.

Cost-effective solution

During the 1990s, Helgerson says, DVI will also become a cost-effective solution for home consumers' multimedia demands. For now, though, the DVI hardware manufacturers as well as the application developers have their sights set on the business and professional marketplace.

Intel's first DVI product, the Pro750 Application Development Platform, started shipping in July. It includes a 386-based microprocessor with three add-in boards, a 40-megabyte hard disk, system software, and various authoring and production software tools. It is priced at $21,500.

The add-in boards contain the VLSI chipset developed by the Sarnoff researchers. An early objective of the Intel/IBM partnership is to reduce the three-board DVI circuitry to a single board incorporating the current DVI chips, and to expand it beyond the current PC AT configuration into IBM's PS/2 architecture. Single-board DVI products should be out by 1990's first quarter, Brannon says.

Beyond that initial goal, he notes, the Princeton Operation is applying Intel's semiconductor expertise to produce a new generation of low-cost, highly integrated DVI chips and boards. These products are due out during the second half of next year.

Along with their team effort to develop DVI hardware and software, Intel and IBM plan jointly to establish a technology center. To some observers, the technology center is likely to be little more than a thinly guised joint-marketing scheme, but Brannon and Gupta claim otherwise.

Jonathan Levine

Rob Lippincott, director of market development for Lotus' Information Services Group: "Our only current problem with DVI is that the installed base is zero"

The center will provide an "open forum" for personal computer manufacturers, customers, and developers such as Compaq Computer Corp., Ing. C. Olivetti & Co. and Tandy Corp. to meet with IBM and Intel to discuss DVI, Brannon says. Intel's other customers, the application developers, will also be able to sit down with both companies and get the definitive word about issues such as CD-ROM/XA support or VGA integration, he says.

The applications developers themselves, meanwhile, are struggling to get multimedia projects under way in the absence of any established market. "Our only current problem with DVI is that the installed base is zero," says Lotus' Lippincott.

Another barrier noted by some industry participants is that multimedia titles will require a merging of talent from the video production world and from the computer software industry. To some extent, though, that convergence has already occurred thanks to analog interactive video disc technology, according to DDRI's Helgerson.

"All those firms who have learned how to produce the interactive video discs are now going to have to learn the digital side," according to Helgerson. "But it's an easier port, because there is an existing track record

of lessons learned."

Lippincott believes this merging of mindsets between video producers and computer programmers will become the key aspect of the emerging multimedia market. "Soon, the kinds of tools that you need to bring together all the elements of multimedia will be as available and as understood as any other type of production tools," he says. "Then the critical shortage will be of truly good ideas, truly well implemented."

Applications for training

What types of multimedia applications are likely to appear first? "Training" is the word on every developer's lips.

"Training will be the first large-scale, universally understood multimedia submarket," says Lippincott. Microsoft's Singh, meanwhile, says, "Training is the be all and end all of where full-motion video can be really valuable in business applications."

If, for example, a company wanted to teach sales skills to its employees, "The ideal way to do this is to set up a sales call environment and then ask the [students] to make decisions in that context," Singh explains.

"It is very hard to convey that environment with text or still photos," he adds. "The only way to set up a seemingly real situation is to show people's faces and their interactions. You can simulate that environment very effectively through full-motion video."

Multimedia will also be called upon to assist people learning and using standard software packages, developers predict. "Something as pedestrian as 1-2-3 may not appear very vulnerable to multimedia," says Lippincott, "but people suddenly light up and say, 'Wow, do you mean I can suddenly talk to someone about how to proceed to the next step? Do you mean I could handle different kinds of information like audio messaging in a spreadsheet format?' People aren't used to doing it, but they can see how it might work."

Many observers expect DVI to dominate in the personal computer marketplace

Beyond training, other potential multimedia markets include that of desktop media, with which personal computer users could perform video editing and create presentations, Lippincott says. In addition, he sees great potential for multimedia to serve as a vehicle via which companies can disseminate "commercial messages" and product demonstrations, in something of an audio/video equivalent to ads in magazines.

While Lotus and Microsoft claim to be interested in the whole spectrum of DVI/multimedia applications, it is the technology's potential impact on standard, everyday software that most motivates them. Singh says that multimedia will be analogous to graphics interfaces such as Windows and Presentation Manager in its pervasive effect, and says that Microsoft can only benefit by being in on the ground floor of DVI development.

"If you look at the last 10 years, the software products that survived had to remain competitive," notes Singh. "To remain competitive, they had to take advantage of what the best [computer] platforms offer. Those companies that plan to survive will evolve their products to take advantage of multimedia capabilities as soon as they become available."

At Lotus, "I think almost every one, if not every one, of our products will have multimedia enhancements," says Lippincott. He expects there to be a "paradigm shift" over the next decade in user expectations about what to expect from software.

"Software that doesn't come with multimedia will feel like black and white television, or less," Lippincott concludes. □

Why DVI fuels optimism among its backers

What is it about the Digital Video Interactive technology that fuels such optimism among its backers? In a phrase: compressed full-motion, full-screen digital video. The technology also supports text, graphics, audio, and video stills, but it is DVI's full-motion video compression and decompression scheme that has so far set it apart from the competition.

The medium of choice for most multimedia applications is CD-ROM because of its huge storage capacity — a single CD-ROM disc can hold up to 648 megabytes of digital information. But even this capacity falters when confronted with the storage demands of full motion video.

Standard television-type video runs at 30 frames per second and each analog frame converted to digital data requires about 600 to 750 kilobytes of storage. As a result, even a 648MB CD-ROM disc can hold only about 30 seconds of digital video. In addition, CD-ROM drives read data out at a rate of only 150 kilobytes per second, and thus require about one hour to show 30 seconds of video.

To overcome these kinds of limitations, the SRI/David Sarnoff Research Center team created a compression algorithm that reduces the digital storage required per frame to below 5 kilobytes. This reduction permits application developers to store more than one hour of full-motion, full-screen video on a single CD.

The compression process itself is a tortuous one: it takes a VAX or Meiko computer from four to six seconds to compress each video frame when creating a CD master disc. Intel's Princeton Operation offers the only DVI compression service now available, charging $250 per minute of full-motion video compressed. The company plans to open other compression sites and may license the process to outside firms.

To achieve real-time decompression and display of the compressed data, the DVI developers built two VLSI chips and later enhanced them. One chip is a pixel processor that operates at 12.5 million instructions per second. The second chip, an output display processor, handles resolution modes, pixel formats and color. □

High tech's high debt worries financial community

As mergers and acquisitions increase, so have the debt burdens of electronics firms. In an industry where revenue falls sharply when business slows, Wall Street is ever watchful

BY RAY WISE

Prodded in part by mergers and acquisitions, the debt burdens of some electronics companies have grown close to the point of raising eyebrows on Wall Street, where the financial community already views high tech as too volatile to merit much leverage. The low valuations prevailing on the stock market might lead one to believe the industry doesn't deserve much equity financing, either.

The 50 largest electronics companies, accounting for more than $200 billion of the industry's sales, had a weighted average debt to total capitalization ratio of 28.5% last year. That cuts deeply into the 25% to 30% range widely viewed by analysts as constituting enough debt for the industry, and it is infinitely greater than the zero debt that the conservative wing prefers, especially for younger technology companies.

Reflecting mergers and acquisitions, some of the big companies build debt ratios well above 30%. The debt ratio of Unisys Corp., which acquired Convergent Technologies Inc. in 1988 and Sperry Corp. two years earlier, last year amounted to 41.7% of total capitalization. Computer Associates International Inc. of Garden City, N.Y., an aggressive acquirer, trimmed its debt ratio in 1988 to 19.4% from the year-earlier 32.8%. A company can reduce its ratio either by paying off debt, building retained earnings or both. Increasing retained earnings expands stockholders' equity and, thus, total capitalization.

Merger and acquisition activity has boomed in the electronics industry in recent years, and, according to the Bank of Boston, a lender to the industry, the trend continues. "We have seen an upsurge of lending activity, and the biggest upsurge is in financing acquisitions," says Stan Sakai, vice president in the high-technology sector.

Debt ratios of more than 30% are common in basic industry, and ratios of 50%, and even higher, are found among utility companies. But what could be more predictable than the cash flow of an electric company? It is a very safe bet that the populace will be turning on lights 10 years from now, thus generating revenue for utility companies and enabling them to pay their debts.

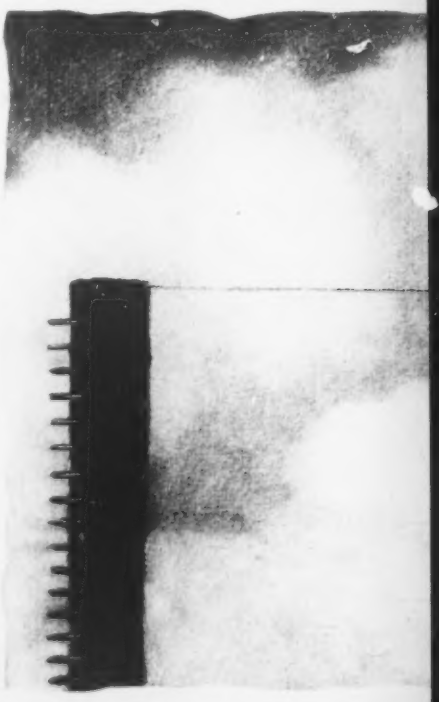
High tech's uncertainty

But nobody knows what kind of desktop computers will be in use a decade from now. It's that uncertainty, along with the electronics industry's product life cycles, that governs the financial community's perceptions of high-tech debt tolerance. "The product life cycle in technology is three to five years, and then the company is scrambling for market share," says Norman J. Schindler, senior vice president in the corporate finance department of Shearson Lehman Hutton Inc. If the next-generation product doesn't meet expectations or it is introduced late, he says, revenue could be penalized and the payment of interest made burdensome.

Analysts fret especially about credit worthiness in the hardware sector — with its massive shift from mainframes to desktops — where, says Sakai, "operating cash flow tends to fluctuate, so there is a perception that it is not wise to leverage hardware companies." Moreover, the proliferation of commoditylike personal computers has pressured profitability.

"The PC market is dynamic and inherently risky. The market forces are strong, backlogs small and reaction times short," according to Moody's Investors Service, New York, in its publication, "A Moody's Special Comment." In the personal computer business, says the rating service, "errors in judgment are expensive and recovery can be difficult."

Analysts scrutinize debt ratios very carefully in this environment, seeking such beacons of financial stability as breadth of product line, which, for example, is lacking at Compaq Computer Corp., according to Schindler. This disadvantage, he says, offsets Compaq's picture-book financials, which feature a steep, six-year climb in earnings per share and cash flow, and explains why Compaq's senior



debt has a rating of only BBB-, the lowest investment-grade category.

Compaq's strict reliance on retailing worries Byron N. Walker, senior analyst for Moody's, which forecasts that the increasing sophistication of desktop computers eventually may mandate the use of a direct salesforce.

Prospect of revenue declines

What bothers many in the financial community who must size up debt tolerance in technology is the very real prospect of sharp declines in revenue when business slows. "Food companies experience 5% declines in revenue; in technology it can be 20% to 30%," says George Putnam III, president of New Generation Investments Inc. and a trustee of The Putnam Funds, both located in Boston. Putnam also points out that while companies in other industries can cut back on research and development to pay debt service costs when times are tough, this is not an option in high tech.

In fact, according to analyst Schindler, the R&D program is one important indicator of an electronics company's financial soundness and its capacity to make a long stream of future interest payments. All other things being equal, a company with a $300 million R&D effort would garner a higher credit rating than a company spending $50 million, Schindler says.

"Either a narrowly focused research effort or a narrowly focused product line can result in a 'junk' credit rating," Schindler notes. Offers Moody's Walker, "You want to be sure the company is investing for the future." Reassuringly, both analysts demonstrate that handing down credit ratings entails a great deal more than juggling debt ratios, cash flows and other numbers. When they analyze a company's ability to service debt, they open it up surgically, look inside and assess its future.

Reflecting mergers and acquisitions, some big companies build debt ratios well above 30%

IBM had a debt to total capitalization ratio of 25.3% last year, which might seem like a sizable burden if that were all one knew about the company. But IBM, of course, is a bastion of financial strength, whose powerful cash flow and earnings streams simply overwhelm debt service costs. For Big Blue, paying its debts is a piece of cake.

IBM not high tech?

Yet Wall Street no longer categorizes IBM as high tech, on the grounds it is too big, too mature. Based on 1988 sales figures, IBM is more than five times larger than the next largest U.S. computer maker, Digital Equipment Corp., itself a big, well-established firm. For the younger, faster growing ventures — even those with annual sales approaching $1 billion — debt servicing can pose challenges that many of them have never experienced, not having existed at the time of the 1981-1982 recession.

Thus, says Jim Timmins, a partner of Hambrecht & Quist Inc., San Francisco, a company's ability to pay its debts reflects its stage of development, as measured by:

- The number of years it has been in existence;
- The predictability of its profits;

Dave Cutler

- The breadth of its product line;
- The depth of its customer base.

Timmins elaborates on the "breadth of product line" concept by noting that a computer company in a very stable sector of the market can take on leverage more readily than a data storage firm. "The companies that stumbled usually were in markets that changed very dramatically, and they couldn't respond quickly enough," Timmins adds. The capacity to cope with change partly reflects the diversity of the product line and the ability to shift from one market to another.

Risk of debt financing

Some analysts simply rule out debt financing as an option for the less seasoned high-tech companies. According to analyst John Wyman, senior vice president for the A.R. Schmeidler & Co. investment firm, New York, "The smaller technology companies should not use leverage, because they have unpredictable cash flow. The risk is that debt service coverage could become inadequate."

Corporate expansion burns up cash flow and can make debt an insupportable burden, especially for emerging companies. "For technology companies growing more than 25% a year, taking on a lot of debt doesn't make sense," states Katherine Kirk, principal in the Boston office of Hambrecht & Quist.

Moreover, these emerging companies must convince their customers and prospects that they have enough staying power to supply their needs for years to come. "A high degree of leverage is not very reassuring to customers, especially in the computer and semiconductor sectors," Schindler of Shearson Lehman Hutton explains. Likewise, Walker says of Moody's: "I get phone calls from people who are buying proprietary equipment and wonder whether the vendor has the financial wherewithal to support their product streams in the future and can supply the next generation of equipment."

Some analysts rule out debt financing as an option for less seasoned companies

Another problem confronting younger high-tech companies hoping to leverage themselves is that their balance sheets rarely show enough in the way of fixed assets to satisfy bankers. Only after these upstart firms have accumulated such tangibles as inventory and receivables and moderated their cash-burning growth somewhat are they ready to obtain debt financing, says Paul Graf, former general partner in Schroder Venture Managers, a New York-based venture capital firm, who has since started his own company.

Debt not only indicator

Even for larger companies, debt ratios are not the only indicator of the capacity to service debt, nor does the financial community apply these ratios rigidly. Cash assets that will not be needed for operations or to placate restive stockholders serve as an offset to a company's debt.

This is especially true of companies generating high rates of return on investment and, therefore, under no pressure from shareholders to dispense such rewards as dividends or a stock buyback program. Because these companies are so well positioned, their cash reserves take on a "long-term look," justifying the analyst in figuring debt with the cash netted out of it.

The debt capitalization ratio of Apple Computer Inc., for example, amounted to 11.3% in 1988, compared with zero in previous years. The debt is short-term borrowing of the kind often used for such seasonal needs as financing inventory or receivables, and more importantly, Apple didn't really need the money. As of June 30, Apple had $707 million in cash. Borrowing in the United States was undertaken simply as an alternative to repatriating cash from Apple's overseas subsidiaries and, thus, was roughly analagous to an individual's borrowing against a bank balance, which really doesn't constitute going into debt at all.

What about high-tech companies — with less than Apple's $707 million in the bank — that can't obtain debt financing needed for expansion? Dan Miller, senior vice president and senior analyst for The Putnam Companies, suggests three possible alternatives:

- Finance expansion internally, that is, with earnings;
- Hit a lot of home runs with the product line and then obtain equity financing at attractive valuations; or
- Find a partner with deep pockets.

"It's a difficult problem," Miller acknowledges. □

Top electronics companies' debt to total capital

Low debt				
Intergraph	0.7%	1.0%	3.7%	3.2%
Scientific-Atlanta	1.4%	3.5%	15.2%	6.8%
DEC	3.6%	4.2%	5.8%	15.7%
National Semiconductor	3.8%	11.3%	15.2%	27.2%
Microsoft	5.1%	2.9%	1.3%	0.0%
Median	24.9%			
High debt				
Xerox	58.1%	27.9%	28.4%	29.1%
SCI Systems	58.3%	58.3%	41.6%	44.6%
Pitney Bowes	63.5%	29.5%	21.4%	21.0%
Emerson Radio	66.9%	67.4%	60.5%	59.9%
LPL Investment Group	91.7%	93.3%	NA	NA

Debt to total capital includes long-term debt plus short-term debt as a percentage of shareholders' equity and long- and short-term debt

Source: ELECTRONIC BUSINESS

Spate of mergers challenges Europe's top companies

In their rush to build pan-European empires as 1992 approaches, European firms are cautioned against "unwieldy" growth — and against just getting products out the door

The annual ELECTRONIC BUSINESS ranking of the top electronics companies in Europe, compiled by senior editor Linda Stallmann, follows this story.

BY BARBARA N. BERKMAN

Among the brotherhood of top-ranked European electronics companies, a rite of passage has been the merger.

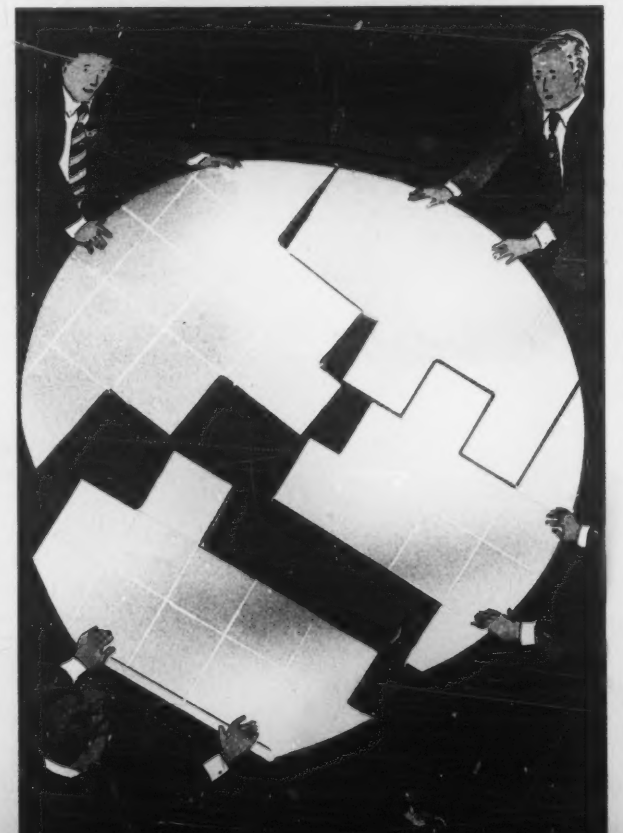
The latter part of this decade has been punctuated by one merger after another, as European electronics companies scramble to build pan-European empires. Driven by the need to achieve economies of scale to fund the high cost of research and development and of capital investment, all were motivated to leave behind small home markets.

The result has been a wave of marriages among European companies. In Britain alone, computer industry acquisitions increased 49% in the first half of 1989 over the same period last year, according to Regent Associates, a London consulting firm specializing in mergers and acquisitions. Britain's Racal Electronics plc leads the pack, acquiring four other companies during that period. It was also a year of hostile takeovers: A joint bid by West Germany's Siemens AG and Britain's General Electric Co. (GEC) plc swallowed Britain's Plessey Co. plc.

Those Europeans with global aspirations also stepped up investment in U.S. electronics companies. In 1988 European companies invested $33 billion to acquire U.S. companies of all types, according to market researcher Arthur D. Little Inc., based in Cambridge, Mass. In electronics, recent examples show that the trend continues.

France's Groupe Bull is expected to pay up to $635 million for the microcomputer business of Zenith Electronics Corp., which should double Bull's U.S. sales to $2 billion. British Telecommunications plc agreed to buy Tymnet, a public data network, from McDonnell Douglas Corp. in July. In August, Siemens took possession of Rolm Co., whose manufacturing and research and development operations in Santa Clara, Calif., became a wholly owned subsidiary and whose marketing and service activities in Norwalk, Conn., became owned jointly with IBM.

The spate of mergers creates a strategic challenge for Europeans. "The way in which these organizations are growing is getting too unwieldy," charges Ivor Cohen, a director of Britain's AB Electronic Products Group plc, which makes a wide range of electronic products. He predicts managers in these conglomerates will spend more of their time focusing on getting products out the door, keeping a close eye on functions such as research or distribution. But contract manufacturing and assembly will increase, following the lead of Japanese companies and even IBM, which surround themselves with a web of subcontractors.



European companies also went through a period of reorganization last year, particularly in Europe's defense electronics sector. Fueling the wave of defense restructuring was the drive to concentrate on profitable core businesses. For these companies, the increasing cost of development and production of defense equipment, coupled with the pressure on European defense budgets, proved too expensive.

In defense, a realization is sweeping through some of the companies and countries of what they can and cannot do on their own. "It is no longer feasi-

ble to develop very sophisticated defense systems exclusively for their home markets," notes Piers Whitehead, an analyst with the London brokerage firm Robert Fleming Securities Ltd.

The Dutch N.V. Philips GL is shedding its defense assets to focus on telecommunications and nonmilitary electronics, selling most of its European defense operations to France's Thomson-CSF SA Aerospace Group, the defense arm of Thomson SA. The deal represents a strategic move toward Thomson-CSF's core business, strengthening its position as Europe's leading defense conglomerate. Plessey's naval and avionics businesses were taken over by British GEC-Marconi Instruments Ltd., while its other defense operations are expected to give Siemens increased market share in military communications, command and control systems and radar.

The companies' restructuring has won accolades from the European financial community. Once considered to have lost sight of their more profitable operations, companies such as Philips, GEC, Siemens, Sweden's LM Ericsson, Finland's Nokia Oy and France's Compagnie Generale d'Electricite (CGE) are performing steadily. London's stock exchange is particularly bullish on companies in the telecommunications equipment market, expected to grow at 20% annually, estimates London brokerage firm James Capel & Co. Total European telecom demand should rise by 37% in 1990, with Ericsson and CGE riding the crest.

Restructuring European companies placed a number of nonmilitary, noncore businesses on the block as well. Both U.S. and Japanese companies have seized them as a means of easy access to the European market. "The turbulence and change that's going on is giving U.S. companies an opportunity to determine entrance mechanisms to the market," observes Barry Bright, management executive consultant in the strategy practice of Ernst & Young in London.

Movement to 1992

Indeed, Japanese, Pacific Rim and U.S. companies seeking a toehold in Europe in preparation for the single market in 1992 are stepping up activities. As in the past, companies are investing directly in European manufacturing facilities, such as Intel Corp.'s recently announced plan to build a wafer fab plant near Dublin.

There are also the traditional joint ventures: Ericsson will own 60% of a joint venture in cellular telephone handsets and private mobile radios with the U.S. General Electric Co. But it will become more common for non-Europeans to choose acquisitions as the common access route to the single market, as Europeans shed assets or look for strong partners to weather the tougher competition expected in 1992.

Already, the pace of such acquisitions is increasing. In September, AT&T announced its acquisition of Istel Ltd., a British data-networking company. Kyocera Corp., a Japanese ceramics and electronics group, bought AVX Corp., the leading maker of multilayer ceramic capacitors used in integrated circuits. The deal gave Kyocera an important European base, as AVX has plants in Ireland, Britain, West Germany and France. Japanese companies are readying to increase European production of consumer electronics, and their suppliers are expected to follow.

European-bred companies still show their traditional weakness in data processing

The Western European market for consumer electronics in 1989 was $18 billion, Capel estimates. Leading the consumer electronics industry is Philips, with 28% of the European market, followed by Thomson with 15%, Sony Corp. and Matsushita Electric Industrial Co. Ltd. with 12% each and Nokia with 9%.

Philips' consumer products sector has improved in profitability since restructuring began in 1987. In 1988, 12.3% of revenue from Philips' core businesses came from consumer products, and 32% of profitability, with a significant increase in sales of color televisions and compact disc (CD) players in the United States. Philips won the largest single order of televisions — more than $150 million worth — when it agreed to supply 300,000 color TVs, 16,000 video cassette recorders and 8,000 satellite dishes to Whittle Communications LP, a print media and television corporation in Knoxville, Tenn.

Philips is enjoying its share in the growing European demand for consumer electronics. It is a market driven by new technologies such as CD interactive and CD video, high-definition television and satellite systems. The European Economic Community is taking a dominant role in cultivating that technology. For the past three years it funded 35% of a $500 million European research effort in HDTV; trials should start in 1990. To protect European CD makers, the EEC in July imposed antidumping duties of up to 33.9% on Japanese CD players.

Still weak in data processing

European-bred companies, however, still show their traditional weakness in data processing. Although West Germany's Nixdorf Computer AG and Italy's Ing. C. Olivetti & Co. SpA have been among Europe's stronger computer makers, both have gone through recent retrenching. Unlike their U.S. counterparts, European manufacturers generally have been slow to move to smaller, networked solutions. "With computers, the big issue in Europe is, who is going to end up with whom?" Ernst & Young's Bright asks.

The European market will not support Bull, Nixdorf and Olivetti, he predicts, and major collaborative deals or perhaps an acquisition will result. Until then, European computer makers are showing signs of recovery that should strengthen their ability to compete with their counterparts in the United States. Olivetti's earnings, for example, are projected to grow by 39% in 1990. Troubled Nixdorf's cost-cutting measures won't demonstrate results until 1990, but progress is good. Nixdorf had kept costs in mid-1989 to the same level as the past year. Now the German computer company expects to report an operating profit in the year's second half.

Daring strategies might be necessary to compete in the 1990s in the market shaping up for data processing in Europe. Demand for information systems is expected to increase sharply when the financial community deregulates in 1992. □

Top electronics companies in Europe — 1988

Rank	Company	Electronics sales ($ millions)	Electronics sales as a percentage of total sales	Total consolidated sales ($ millions)	Profit before tax as a percentage of sales	Profit after tax as a percentage of sales	Sales per employee	Profit before tax per employee
1	**Philips**	$20,803	73%	$28,382	1.4%	0.9%	$91,468	$1,321
2	**IBM**	20,520	34%	59,681	15.1%	9.2%	154,170	23,334
3	**Siemens**	17,389	51%	34,140	4.2%	2.3%	96,713	4,032
4	**CGE**	12,226	57%	21,482	4.3%	1.1%	105,250	4,532
5	**Thomson**	11,149	89%	12,563	5.1%	1.6%	121,148	6,205
6	**GEC**	6,795	65%	10,404	13.6%	8.7%	71,734	9,723
7	**Olivetti**	6,375	99%	6,459	5.1%	4.2%	112,212	5,774
8	**Robert Bosch**	6,265	40%	15,762	8.0%	2.0%	95,104	7,570
9	**Groupe Bull**	5,296	100%	5,296	2.0%	0.7%	116,252	2,324
10	**Digital Equipment**	5,130	40%	12,742	11.1%	8.4%	101,287	11,293
11	**Matsushita**	4,566	11%	42,907	9.6%	3.9%	222,213	21,374
12	**Ericsson**	4,290	84%	5,101	6.8%	4.2%	78,317	5,305
13	**STC**	3,936	94%	4,196	9.8%	6.1%	123,968	12,098
14	**Xerox**	3,908	24%	16,441	6.1%	2.4%	145,181	8,875
15	**Sony**	3,493	21%	16,723	7.7%	3.4%	235,539	18,172
16	**Hewlett-Packard**	3,304	34%	9,831	11.6%	8.3%	113,000	13,126
17	**AEG**	3,303	43%	7,620	1.0%	0.2%	85,062	833
18	**Nokia**	3,208	62%	5,207	5.0%	3.7%	116,789	5,818
19	**Nixdorf**	3,045	100%	3,045	NA	NA	98,114	NA
20	**British Telecom**	2,965	15%	19,595	22.0%	14.3%	80,729	17,770
21	**Unisys**	2,888	29%	9,902	9.7%	6.9%	106,473	10,308
22	**Canon**	2,649	31%	8,631	7.8%	3.4%	211,856	16,440
23	**Asea Brown Boveri**	2,600	15%	17,832	3.0%	2.2%	105,229	3,163
24	**Memorex Telex**	2,242	100%	2,242	2.5%	1.7%	203,802	5,152
25	**NCR**	1,975	33%	5,990	13.1%	7.3%	99,832	13,119
26	**Grundig**	1,903	100%	1,903	4.8%	4.1%	97,975	4,719
27	**Bayer**	1,822	8%	23,048	9.3%	4.7%	139,252	12,993
28	**Racal**	1,770	63%	2,813	11.2%	7.9%	83,469	9,345
29	**Toshiba**	1,693	6%	29,628	6.2%	3.1%	237,028	14,644
30	**Hitachi**	1,523	3%	49,900	7.7%	2.9%	181,781	13,946
31	**Ferranti**	1,522	82%	1,865	5.3%	3.6%	81,710	4,327
32	**Schlumberger**	1,500	30%	4,925	12.0%	9.2%	102,594	12,261
33	**Motorola**	1,500	18%	8,250	7.4%	5.4%	80,882	6,000
34	**Matra**	1,483	46%	3,245	5.3%	1.8%	166,595	8,851
35	**Mannesmann**	1,244	11%	11,631	4.4%	2.1%	95,506	4,166

NA = Not available

Electronics sales: Represents ELECTRONIC BUSINESS' estimate of the revenue earned by each company from the sale of electronics products.

The figure shown is based on the latest available completed fiscal year, thus a variety of accounting periods are represented.

Similarly, the electronics sales and other financial information has been converted to dollars using an exchange rate that consists of the average rate during each company's fiscal year.

For European companies, the figure shown is their worldwide sales of electronics products, including those manufactured and sold outside Europe: for non-European companies the figure estimates their electronics sales in Western Europe only.

Electronics as a percentage of total sales: Indicates the proportion of electronics products within the total consolidated sales of all the products of the company. For firms not European owned, the percentage relates to their electronics sales in Western Europe as a percentage of total consolidated worldwide sales.

Profit after tax per employee	Fixed assets per employee	Investments as a percentage of sales	Return on gross capital employed	R&D as a percentage of sales	Capital expenditures as a percentage of sales	Current ratio	Fiscal year ended	Country of origin
$866	$30,269	14.3%	2.4%	8.2%	6.1%	1.54	12/88	Netherlands
14,185	60,515	19.0%	17.1%	9.9%	9.0%	2.03	12/88	United States
2,266	22,151	17.8%	9.6%	10.9%	6.9%	1.87	9/88	West Germany
1,195	17,027	12.8%	12.4%	8.4%	4.5%	1.09	12/88	France
1,938	16,854	9.9%	18.1%	5.6%	4.3%	1.15	12/88	France
6,226	11,317	9.9%	22.1%	5.0%	4.9%	2.07	3/89	Britain
4,754	20,805	12.6%	6.1%	5.4%	7.3%	2.20	12/88	Italy
1,904	15,710	12.9%	18.4%	5.9%	7.0%	2.34	12/88	West Germany
828	32,260	19.2%	4.2%	10.1%	9.1%	1.50	12/88	France
8,526	28,982	21.6%	17.4%	12.0%	9.6%	2.88	6/89	United States
8,618	33,274	11.7%	14.2%	5.8%	5.9%	1.65	3/89	Japan
3,286	16,713	16.8%	10.9%	11.3%	5.6%	1.90	12/88	Sweden
7,622	20,567	14.7%	26.8%	9.0%	5.7%	1.60	12/88	Britain
3,426	17,731	7.9%	10.1%	4.8%	3.1%	NA	12/88	United States
7,956	59,812	16.7%	17.1%	6.6%	10.1%	1.28	3/89	Japan
9,379	28,920	17.0%	26.2%	10.4%	6.6%	1.72	10/88	United States
172	14,838	14.3%	2.3%	8.1%	6.2%	2.08	12/88	West Germany
4,362	28,979	10.8%	10.0%	4.8%	6.0%	1.50	12/88	Finland
NA	31,306	23.9%	-3.7%	9.9%	14.0%	0.89	12/88	West Germany
11,514	98,105	28.6%	19.0%	1.9%	26.6%	0.86	3/89	Britain
7,318	24,467	14.0%	19.8%	7.2%	6.8%	1.69	12/88	United States
7,106	49,066	13.4%	13.2%	5.9%	7.5%	1.60	12/88	Japan
2,278	20,264	11.4%	6.0%	7.3%	4.1%	1.56	12/88	Switzerland
3,509	20,360	3.5%	9.8%	1.9%	1.6%	1.38	3/89	Netherlands
7,321	18,579	14.0%	33.6%	7.0%	7.0%	1.69	12/88	United States
3,990	19,065	10.5%	12.1%	4.0%	6.5%	1.75	3/89	West Germany
6,569	38,436	13.9%	18.7%	6.1%	7.8%	1.65	12/88	West Germany
6,616	26,867	11.7%	18.4%	NA	11.5%	1.61	3/89	Britain
7,446	49,253	12.1%	15.9%	6.1%	6.1%	1.12	3/89	Japan
5,270	41,844	14.2%	14.1%	5.8%	8.3%	1.53	3/89	Japan
2,955	19,673	11.9%	9.9%	5.5%	6.3%	1.51	3/89	Britain
9,456	33,681	16.4%	21.2%	7.2%	9.2%	1.28	12/88	Netherlands
4,363	27,980	19.0%	17.3%	8.1%	10.9%	1.26	12/88	United States
2,922	NA	7.0%	NA	0.0%	7.0%	NA	12/88	France
2,034	18,230	6.4%	12.3%	2.2%	4.2%	1.42	12/88	West Germany

Fixed assets per employee: Shows the accumulated value (less depreciation) of land, buildings, plant, machinery, furniture and fittings (including rental equipment) that the company has invested per employee.

Investments as a percentage of sales: Adds together capital expenditures and research and development as a proportion of total consolidated sales.

Return on gross capital employed: Shows profit before taxes as a proportion of net working capital plus fixed assets and investment (for example, equity holdings and other assets, not capital expenditures).

Capital expenditures as a percentage of sales: Shows the amount of new investment in fixed assets during the year as a proportion of total consolidated sales.

Current ratio: Shows current assets as a proportion of current liabilities, giving a rough indication of the liquidity of the company.

Country or origin: Indicates the country in which the company is ultimately registered.

Source: ELECTRONIC BUSINESS

High yen, competition leveling global playing field

While the top Japanese electronics companies produced healthy growth in fiscal 1989, their U.S. counterparts — thanks to sharp productivity gains — are catching up fast

BY PAULA DOE

Japan's leading electronics companies have recovered from the wallop of the high yen. Electronics sales for the 20 largest electronics producers grew a healthy 13% in the fiscal year ending March 1989, and margins climbed back up to the levels of the good old pre-1984 days.

But in the current period of high yen and increasing global competition, the big Japanese companies don't have the edge they once did. Their U.S. counterparts are matching their revenue growth and continuing to post sharper productivity gains.

ELECTRONIC BUSINESS tracks the results of Japan's major electronics companies from news releases and financial reports published in Japan and interviews with company officials before the English language annual reports trickle out from many of the companies. Usually our survey provides the first good figures available out of Japan.

Our survey shows that Japan's fabled productivity edge continues to fade. U.S. productivity growth, as approximated by sales per employee, outpaced that of the big Japanese companies for the fourth straight year, climbing 10% while the Japanese figure remained flat.

On average, the Japanese still manage to sell more than one and a half times as much per employee as the top U.S. companies. But slow growth over the past several years suggests the Japanese producers may have reached the limit of possible improvement through efficient management, while U.S. companies now adopting similar practices are catching up fast.

When ELECTRONIC BUSINESS began to collect Japanese financial data and compare it with our own ELECTRONIC BUSINESS 200 several years ago, it was rare to find any U.S. companies, other than distributors, with revenue per employee anywhere close to any of the Japanese companies.

This year, however, the leading U.S. companies in almost every segment have revenue per employee above the $185,000 median of the Japanese companies [ELECTRONIC BUSINESS, July 24, 1989]. Many makers of microcomputers, peripherals, software and communications equipment now surpass even the $250,000 level of the best Japanese companies.

Japanese figures are lower

Japanese revenue per employee figures were also lower this year because the big electronics makers added droves of new workers overseas.

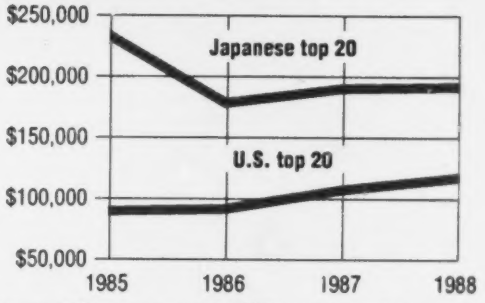
Andrea Baruffi

Japanese versus U.S. electronics companies in 1988

	Japanese top 20	U.S. top 20
Electronics revenue ($ billions)	$195.8	$170.0
Change from 1987	+13.1%	+12.2%
Total revenue ($ billions)	$297.3	$170.7
Change from 1987	+10.6%	+10.7%
Net income ($ billions)	$9.2	$11.8
Change from1987	+43.2%	+2.4%
Net income/sales	3.1%	6.9%
Revenue per employee	$192,000	$116,500
Change from 1987	-0.2%	+10.1%
Net income per employee	$6,300	$8,000
Change from 1987	+49.7%	+1.8%

Conversion rate: ¥132 = $1

Productivity (revenue per employee)



Japanese 1987 figures are recast by 1988 accounting methods; the originally reported 1987 figure was $200,200

Source: ELECTRONIC BUSINESS

without cutting back appreciably at their plants in Japan.

Productivity should improve in the near future as the new plants abroad get fully cranked up and the Japanese workers at home develop new goods with higher value added. But many in Japan suspect that with its new multinational workforce and scattered production sites selected for political rather than economic reasons, the country won't ever regain the productivity edge it once had.

More realistic accounting methods also brought down Japanese productivity figures this year. Japanese revenue per employee numbers have been artificially inflated in the past, because workers at unconsolidated subsidiaries were not being counted even though they contributed directly to making and selling the company's products.

Matsushita Electric Industrial Co. Ltd., Hitachi Ltd. and Sony Corp. all included more subsidiaries in their consolidated financial reports this year. The new standards change reported very little sales and earnings, but they mean big increases in the number of reported employees. We've recast these companies' 1987 results by the same standards for comparison.

Without the advantage of a cheap currency, Japan's leading electronics producers grew at almost exactly the same pace as their U.S. counterparts. Although the Japanese companies have traditionally used aggressive leveraged financing to race after market share and achieve markedly higher rates of growth than U.S. industry growth rates, this year's 13% increase in Japanese electronics revenues was little different from the 12% growth at the top U.S. companies.

The hottest Japanese growth company this year was Sony

Total revenue of the leading electronics companies was up about 11% in both countries.

Contrary to all common assumptions about the lack of potential in the consumer electronics market, the hottest Japanese growth company this year was Sony. Much of the company's 38% increase in revenue came from its successful diversification efforts, including a fat 16% jump from the acquisition of CBS Records Inc.

Sony's sales of nonconsumer electronics products — its semiconductors, floppy disk systems and workstations — grew 22% to account for 15% of total company sales, or about the same as the company's television business. But sales of camcorders and video cassette recorders grew still faster at 27%, and even sales of audio equipment increased a healthy 17%.

Cost cutting

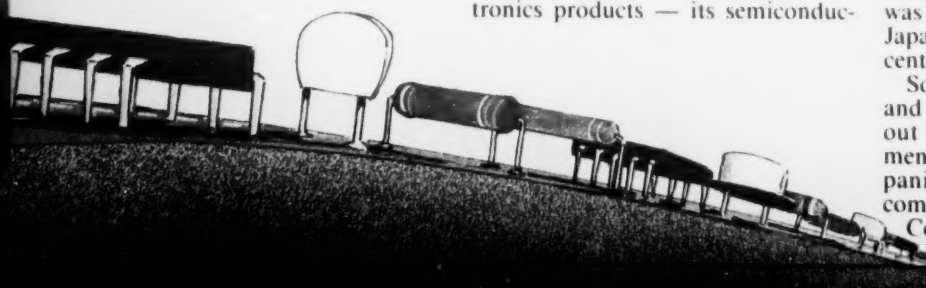
Earnings soared at the Japanese companies, as herculean efforts to cut costs and move up to higher margin products finally took full effect. The big Japanese producers saw their earnings jump 43% overall, compared with a meager 2% growth at the big U.S. companies.

Net income at NEC Corp., Mitsubishi Corp., Canon Inc., and Oki Electric Industries Co. Ltd. more than doubled. This robust Japanese earnings growth brought net income right back up to where it was before the high yen, to about 3% to 4% of sales. That slim margin is only about half the average U.S. figure, but with little pressure to generate income for shareholders, Japanese companies tend to plow their earnings back into growing the business and thus keep net income low.

Probably a better measure of the effectiveness of Japanese cost cutting is operating income. That measure was up an average 59% at the major Japanese electronic companies, to 7 cents on $1 of sales.

Sony, Sharp Corp., Toshiba Corp. and Sanyo Electric Co. Ltd. squeezed out the most impressive improvements in their margins. All four companies doubled their operating income this year.

Components manufacturers who



dominate their niches had the fattest operating margins: Kyocera Corp., 16%; TDK Electronics Co. Ltd., 13%; and Omron Corp., 11%. NTT earned 13% on operations in its still highly regulated telecommunications market.

Canon, moving upscale and overseas fast, managed 8% from copiers, printers, cameras and steppers. Surprisingly, efficient Matsushita and Sony each squeezed respectable operating margins of more than 7% out of consumer electronics. Most of the other big Japanese names in computers and semiconductors earned about 6 to 7 cents on each dollar of operations.

Cost cutting only accounts for part of the recovery in Japanese margins. Companies are also trying hard to move to higher value-added products. Toshiba increased its sales of information and communication equipment and electronic devices from 39% of its total in 1984 to 49% in 1988. Matsushita's sales in the same category climbed from 27% in 1984 to 33% in 1988, Hitachi's from 27% to 32%. □

Japan's top electronics companies in 1988

		Electronics revenue* ($ millions)	Total revenue ($ millions)	Operating income ($ millions)	Operating income/ revenue	Net income ($ millions)	Net income/ revenue	Revenue per employee	Net income per employee	Fiscal year ended
1	**Matsushita**	$30,400	$41,699	$3,161	7.6%	$1,617	3.9%	$216,000	$8,400	3/89
	Change from 1987	+7%	+9%	+16%		+30%				
2	**NEC**	23,355	23,355	1,400	6.0%	488	2.1%	224,500	4,700	3/89
	Change from 1987	+8%	+14%	+64%		+154%				
3	**Toshiba**	20,300	28,794	1,879	6.5%	905	3.1%	230,400	7,200	3/89
	Change from 1987	+19%	+6%	+125%		+97%				
4	**Hitachi**	19,400	48,496	3,282	6.8%	1,406	2.9%	176,300	5,100	3/89
	Change from 1987	+17%	+12%	+36%		+36%				
5	**Fujitsu**[1]	18,087	18,087	1,254	6.9%	530	2.9%	180,900	5,300	3/89
	Change from 1987	+10%	+17%	+57%		+66%				
6	**Sony**	13,700	16,252	1,216	7.5%	549	3.4%	206,000	7,000	3/89
	Change from 1987	+17%	+38%	+165%		+95%				
7	**Mitsubishi Electric**	12,500	20,582	1,189	5.8%	403	2.0%	160,000	6,100	3/89
	Change from 1987	+10%	+15%	+97%		+140%				
8	**NTT**[1]	9,700	44,257	5,555	12.6%	1,689	3.8%	240,200	4,700	3/89
	Change from 1987	—	+3%	-11%		-8%				
9	**Canon**	8,200	8,380	666	7.9%	281	3.4%	205,700	6,900	12/88
	Change from 1987	+12%	+13%	+90%		+180%				
10	**Sharp**[1]	7,700	9,453	360[2]	3.8%[2]	222	2.3%	163,000	3,800	3/89
	Change from 1987	-5%	+2%	+130%		+44%				
11	**Sanyo**	5,500	9,514	113	1.2%	46	0.5%	126,900	600	11/88
	Change from 1987	-4%	+6%	+111%		—				
12	**Ricoh**[2]	4,700	5,500	310	5.6%	130	2.4%	141,800	3,400	3/89
	Change from 1987	+7%	+8%	+1%		+3%				
13	**Oki**[1]	4,208	4,208	273	6.5%	116	2.8%	210,400	5,800	3/89
	Change from 1987	+8%	+23%	+80%		+338%				
14	**TDK**	3,170	3,170	408	12.9%	169	5.3%	158,500	8,500	11/88
	Change from 1987	-1%	+5%	+18%		+34%				
15	**Pioneer**	3,061	3,061	NA	NA	139	4.5%	236,500	10,800	9/88
	Change from 1987	+6%	+11%	NA		+62%				
16	**Omron**	2,822	2,822	301	10.7%	144	5.1%	188,100	9,600	3/89
	Change from 1987	+18%	+18%	+39%		+75%				
17	**Alps**[1,2]	2,700	2,800	60	2.1%	50	1.8%	186,700	3,300	3/89
	Change from 1987	-4%	+6%	-37%		-21%				
18	**Kyocera**	2,200	2,566	411	16.0%	225	8.8%	160,400	14,100	3/89
	Change from 1987	+5%	+13%	+31%		+31%				
19	**Casio**	2,052	2,052	86	4.2%	50	2.5%	256,500	6,300	3/89
	Change from 1987	+3%	+9%	+39%		+38%				
20	**Citizen**[1]	2,000	2,278	153	6.7%	64	2.8%	151,900	4,300	3/89
	Change from 1987	+0%	+12%	+68%		+62%				

Conversion rate: ¥132 = $1

* Electronics revenue change uses 1987 figures as originally reported

[1] Consolidation by Japanese accounting conventions, which differ from U.S. Securities and Exchange Commission rules

[2] Preliminary figures before release of final consolidated results

Source: ELECTRONIC BUSINESS

Dream decade awaits vendors of fiber-optic components

Strong 1990s growth will occur for these end-connection components as fiber-optic applications for computers, telephones and cable television proliferate

BY TAMMI HARBERT

The decade of the 1990s will begin with fiber-optic components makers poised for strong growth. Computer companies will begin introducing machines using the fiber distributed data interface (FDDI), and telephone companies and cable television companies will be trying to bring fiber-optic lines to the home.

Companies that supply the components used to connect fiber-optic lines to electronic systems, including transmitter-receivers and high-level chipsets, are dreaming about the 1990s. In the coming decade sales to markets other than the traditional long-haul telecommunications arena could dramatically increase the volumes of such end-connection components.

The high bandwidth and noise immunity characteristics of optical fiber make it useful for applications requiring high data-transmission rates or in environments with high levels of electromagnetic interference.

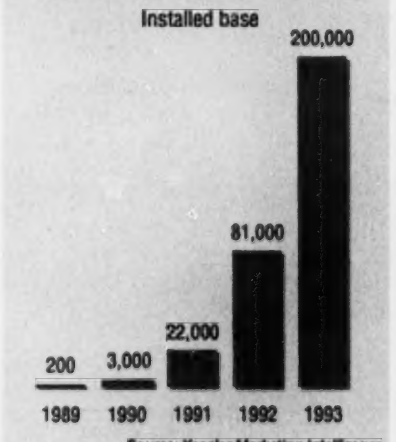
Telecommunications has always made up the greatest share of the market for fiber-optic cable and components. Telecommunications made up 75% of the 1988 North American market, which totaled $1.11 billion, according to ElectroniCast Corp., a market research company based in San Mateo, Calif. But consumption of fiber-optic components for telecommunications is expected to drop over the next couple of years, says Michael Osterman, a research analyst at ElectroniCast., because the major North American telecom companies, such as AT&T, MCI and Sprint, have almost finished installing fiber-optic lines for long-haul telecommunications.

The next largest market for fiber-optic components is datacommunications, making up 16.6% of 1988 consumption. It is this segment of the market that is drawing the attention of many fiber-optic component makers, particularly those that make transceivers, which change light into electronic signals and vice versa, and those that make FDDI chipsets.

But the datacommunications segment isn't growing as fast as market researchers expected. "People just aren't putting in fiber as fast as we thought they would," Osterman says. For LANs, it is much easier to work with copper than with fiber, he says, so unless a network needs the extra security that fiber provides, most network users still choose copper.

One barrier to development of the datacommunications market has been the high cost of fiber-optic components, particularly transmitters and receivers, analysts say. In the telecommunications area, the actual component cost is minuscule compared with the cost of miles and miles of cable. But in datacommunications, analysts note, that component cost becomes a much greater share of the total overall cost of the system.

FDDI transceivers market



Source: Kessler Marketing Intelligence

Most vendors say 1990 will be the year when the fiber distributed data interface will begin appearing in the market. FDDI is a fiber-optic 100 megabits LAN standard being developed by the American National Standards Institute.

"The effect of FDDI is essentially nil right now," says Richard Mack, an analyst with Kessler Marketing Intelligence Inc. (KMI) in Newport, R.I., but it will have a growing impact over the next five years. This impact will be felt particularly in the sales of connectors and transceivers, because each FDDI ring will require at least two transceivers and several connectors, depending on how the network is configured.

The installed base for FDDI transceivers will grow from 200 nodes in 1988 to 200,000 in 1993, a March 1989 KMI study projects. Some industry observers are telling KMI that those numbers are too conservative, Mack says. He suspects that more than 100 computer, subsystem and board companies are currently building FDDI-compatible equipment.

One company that has long targeted the FDDI market is Advanced Micro Devices Inc. of Sunnyvale, Calif., which sells the Supernet FDDI chipset. AMD is seeing "a very rapid adoption of FDDI," according to John Jaeger, product marketing manager in its network products division.

Computer makers will begin to adopt FDDI because they are beginning to require the higher throughputs that fiber-optic cable can provide, according to Schelto van Doorn, general manager of Siemens Fiber Optic Components Group in Evansville, Ind., which is targeting the datacommunications market with its fiber-optic transceiver compo-

nents. The effects of FDDI will be felt in 1990, van Doorn says, predicting that several large computer companies will announce new products capable of using FDDI. The first products will be graphics workstations, he says, because of their high throughput requirements.

FDDI cost still high

The cost of FDDI and fiber optics in general, however, is still high. As a rule of thumb, van Doorn says, the price of an interface board for a network should be 10% of the price of the workstation it runs on. Currently an FDDI interface card costs around $4,000 to $6,000, he says, which means it is only justifiable on high-end workstations.

Nathan Walker, product marketing manager for Hewlett-Packard Co.'s fiber-optic components unit in San Jose, also cites the 10% rule of thumb. With workstation prices falling, the cost for the interface board is going to have to go down as well, he explains.

In order for costs of FDDI-compatible components to come down, two things must happen, Walker says: One, vendors must adopt standard packages, pinouts and specifications for FDDI transceivers so they can be multisourced, and two, the high-level FDDI chipsets must be further integrated so they can sell for a lower price. One other possibility, he says, is that users may decide that the performance provided by FDDI is worth paying a premium, and thus the 10% rule wouldn't apply.

Other networks, such as Ethernet and Token Ring, are starting to use fiber optics, he points out. For example, roughly 10% to 15% of an estimated 1 million Ethernet nodes installed this year are using fiber optics.

In August, Hewlett-Packard, Siemens, and AT&T took a step toward standardization when they announced they had settled on a standard pinout and package for transceivers. The agreement is for interchangeable transceivers compliant with the FDDI physical media-dependent (PMD) standard. The packages will have the same outline, footprint and power supply voltage requirements.

By the end of the century fiber will run into or near 20% of residences

The hope among the three companies is that offering a standard package will stimulate high-volume orders, which in turn will help drive the component prices down to help meet the 10% rule. While FDDI transceivers today cost around $700, customers need a price of about $100 in order to meet the 10% rule, industry representatives say.

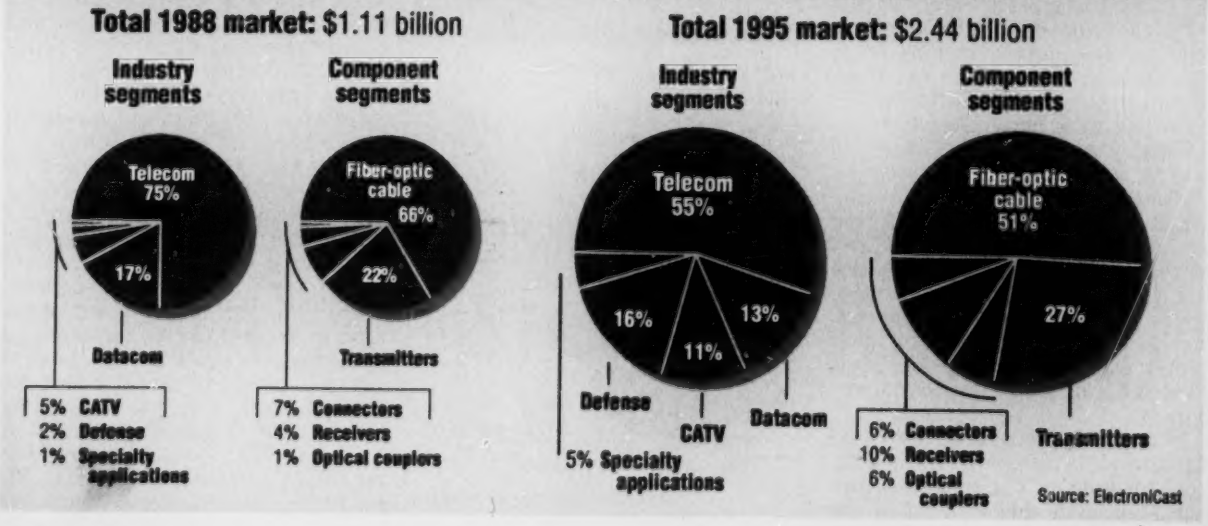
In 1990 prices for transceiver modules will be $200 to $400, says Bill Hackett, manager of product marketing for lightwave components for AT&T in Breinigsville, Pa. That is assuming, however, that volumes will reach 10,000 to 100,000.

But AT&T is also offering another "standard" transceiver. The HP-AT&T-Siemens agreement followed an earlier announcement by AT&T and PCO Inc. of Chatsworth, Calif., that the two companies would market virtually identical transceivers and data links. PCO is jointly owned by Corning Inc. (65%), and IBM (25%).

AT&T agreed to second-source a 16-pin device with PCO because some AT&T customers were already designing based on a 16-pin, four-row configuration, Hackett says. The deal with Siemens and HP settled on two-row, 11-pin configuration. "We are not sure which of those [two package types], if not both, will become major standards," he says. "The market will decide the better design."

In addition to producing the parts in its deal with AT&T, PCO also plans to produce parts that match the HP-Siemens-AT&T agreement, says Michael K. Barnoski, PCO's founder, president and CEO. PCO's position on the two different standards, he says, is to produce both and let the users decide the best design.

North American fiber-optic market



Philips/Signetics in Sunnyvale, Calif., is offering a generic-type transceiver, rather than one specialized for a particular application, in order to sell high volumes at low cost, says Nabil G. Damouny, strategic marketing manager for products communication.

The company's HiFI (high-performance fiber optic interface) transceiver chipset can support a variety of applications in both the datacommunications and telecommunications markets, he says. Thus, the company can sell this product into other areas in addition to FDDI networks, which Damouny says won't reach high volumes anytime soon. "We will not see any high [FDDI] volumes — more than 500,000 nodes — before 1994," he predicts.

Lower priced FDDI chipsets should also be coming in the next year. AMD claims its Supernet chipset has driven the cost of an FDDI station from $35,000 to less than $6,000 today.

In addition, an agreement announced in September by Motorola Inc. and Digital Equipment Corp. may provide some of the competition necessary to drive down prices.

DEC and Motorola's Microprocessor Products Group have agreed to jointly develop an FDDI chipset, which Motorola will manufacture and market to third parties as well as to DEC. The full four-chip set is due to be available by mid-1990 at an estimated price of $300, according to Rhonda Dirvin, communications VLSI marketing manager in Motorola's high-end microprocessor division in Austin, Texas.

Within the next 12 months DEC will introduce a "complete system solution" for FDDI networking, which means it will provide all the components required to operate an FDDI network, according to Karl Pieper, manager of DEC's extended LAN marketing group.

The FDDI market is set to take off in 1990 for two major reasons, Pieper says: First, distributed computing applications are growing very quickly, and the amount of data these networks must handle requires a quicker, higher-capacity connection. Second, the widespread adoption of LANs by individual departments within companies requires some sort of high-speed, high-capacity interconnection.

"FDDI will end up being the interstate highway system of networks," Pieper predicts. DEC already sells fiber-optic repeaters and bridges for its Ethernet networks and resells a fiber-optic Ethernet LAN supplied by a third party.

A number of other recent agreements indicate that component vendors are striving to offer customers as many interchangeable, plug-and-play parts as possible. AMD, for example, is remarketing optical data links from BT&D Technologies, a joint venture of British Telecommunications plc and E.I. du Pont de Nemours and Co. The data links complement AMD's Supernet chipset and are part of AMD's strategy to supply a complete set of integrated products to its FDDI customers, AMD says.

HDTV application

The long term high-volume market driver for fiber-optic components will be the installation of fiber to homes in the 1990s to deliver such services as high-definition video and interactive communications. By the end of the century 20% of residences will have fiber to or near the home, ElectroniCast estimates.

And as fiber applications for the home grow, the datacommunications market will increasingly overlap with the telecommunications market, PCO's Barnoski says. There are currently about 25 trials, among both telephone and cable TV companies, under way for connecting fiber to homes. He expects large sales volume from such applications by 1995.

Another strong driver in the telecommunications market is the SONET (synchronous optical network) standard, says Greg Dougherty, manager of telecommunications marketing for AT&T's lightwave components. Telecommunications vendors are currently designing new transmission equipment around the standard, which will specify digital hierarchy optical interface rates and formats.

In all markets, fiber-optic component makers seem to be putting all their strategies in place and preparing to produce in high volumes. Whether those volumes begin to materialize over the next two to three years may depend on the kinds of prices users are willing to pay for the increased performance fiber offers. "The key," AT&T's Hackett says, "is to inspire OEM confidence in the technology by providing interchangeable parts at reasonable costs." □

Military markets due for dramatic growth

The military segment of the market for fiber-optic components is projected to experience dramatic growth within the next five years. That segment is expected to grow from $23.4 million, or 2% of the market, in 1988 to $397 million, more than 16%, in 1995, according to market research firm ElectroniCast Corp.

A major driver in the defense segment is the NLOS FAAD (non-line-of-sight forward-area air defense) program, formerly called the FOGM (fiber-optic guided missile) program, according to Michael Osterman, research analyst at ElectroniCast. The NLOS FAAD system, while it still awaits funding, consists of a missile that has a fiber-optic link to the missile. After it is fired, the pilot will be able to guide the missile to its target.

The program could be a major driver for fiber optics in the military, agrees Chuck Jackson, lightwave military product marketing and management manager at AT&T Microelectronics. He says that the program involves building 80,000 to 100,000 missiles, each of which would require a transmitter and receiver. However, he adds, production of the missiles is not anticipated to start until 1993 to 1995.

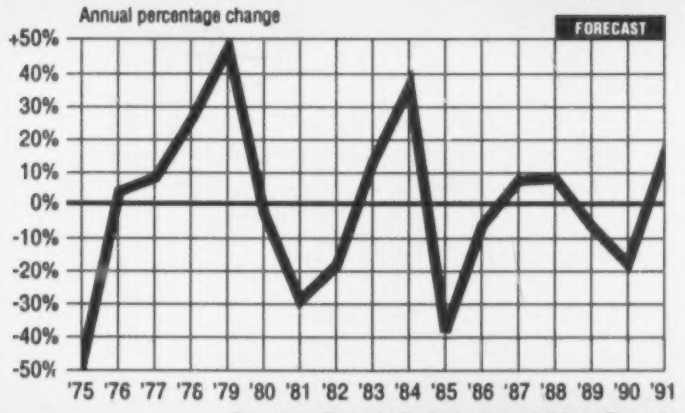
Another force in the military that will increase the use of fiber optics, Jackson says, is a program being conducted by the Joint Avionics Working Group to encourage standardization among fiber-optic avionics designs. The program would set up a standard schematic of everything on an airframe, so that designs for one branch of the military can be used for the other two branches as well. □

Leadtimes in detail

Average delivery times in weeks	3rd qtr. 1987	3rd qtr. 1988	3rd qtr. 1989	FORECAST 3rd qtr. 1990
Discrete semiconductors	7.3	7.1	6.4	6.0
Integrated circuits	7.9	7.3	5.9	5.8
Memory circuits	10.2	15.4	9.0	6.5
Microprocessors	9.2	9.7	7.5	6.8
Displays	8.7	8.7	8.2	6.8
Capacitors	6.2	7.2	6.3	6.7
Connectors	6.8	7.4	6.1	6.0
Printed circuit boards	6.3	5.6	5.5	5.3
Relays	7.6	8.1	7.0	7.2
Resistors	4.9	5.7	4.9	4.1
Switches	6.5	6.3	5.6	6.0
Wire and cable	4.5	3.8	3.8	2.6

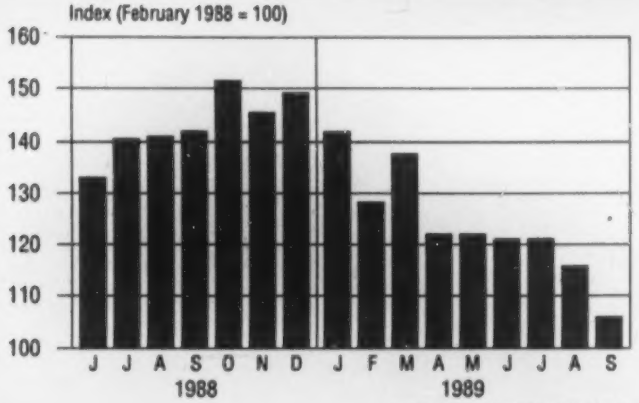
Data source: *Electronics Purchasing*; Forecast: Cahners Economics

Electronic component leadtimes



Data source: *Electronics Purchasing*; Forecast: Cahners Economics

Semiconductor price index



Data source: *Electronics Purchasing*

Component buyers report both bad and good news

Looking for a useful reality check on your company's forecast? Check with those in the industry who know first what business will be doing — those who have to buy the components before production can take place. They are the purchasing agents for electronics companies.

Before the Commerce Department releases a single inventory number, buyers respond to two extensive surveys each month run by Cahners' *Electronics Purchasing* magazine. The magazine's new price survey, begun in 1988, provides actual transaction prices for 130 types of semiconductors and passive components.

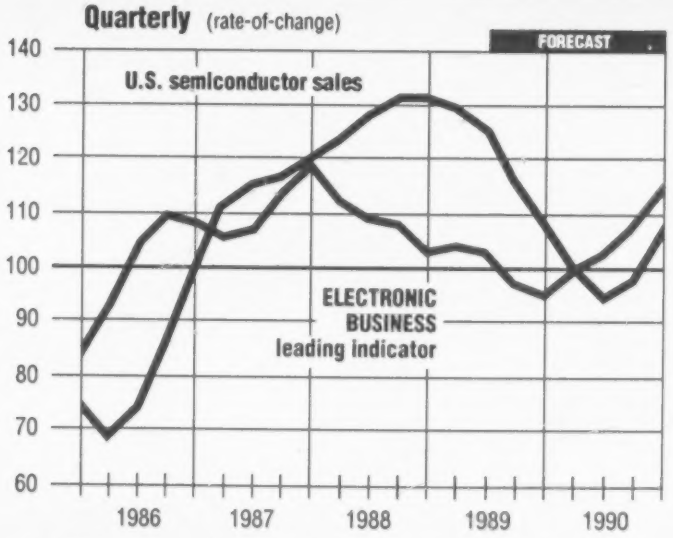
Here's what buyers are reporting now:

- Good news on inventories. Only 37 days of supply were on hand in September, down from 55 days of supply a year earlier. Buyers at electronics companies are feeling so good that only 33% said they were reducing inventories in September, down from 49% in August and 47% a year ago. Apparently, inventory levels now may have gotten uncomfortably low for manufacturers. Compared with the 1984 responses, excess inventory accumulation clearly has not been going on.
- Semiconductor prices continue to fall. On average, actual transaction prices for semiconductors have fallen 18% below year-ago levels. Memory chip prices, the main culprit of last year's price wars, have deteriorated severely. Prices of 1Mb DRAMs were reported at $13.81 in September, down 55% from $31 last year. Chances are the current price decline isn't over yet, either.
- Delivery times for most components continued to fall this past summer and early autumn. The annual rate of growth in our composite index of all components' leadtimes peaked in August of 1988 at 15.5% and has been falling ever since. This past September, leadtime growth declined 4.1%. While not as dramatic as the 58% peak leadtime gain seen in 1984, or the 26% drop 13 months later, the leadtime data do point to a slowdown or mild downturn in the electronics business next year.

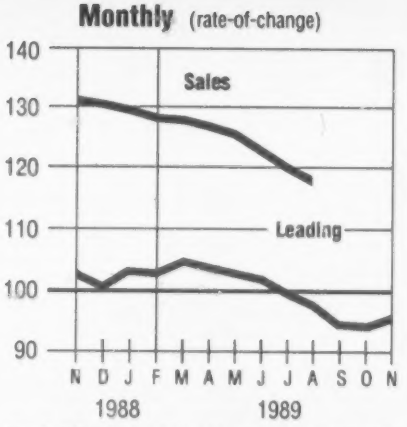
These data and more from *Electronics Purchasing* are some of the reality checks on Cahners' own forecasts. So far, buyers continue to confirm that a slowdown or mild downturn will be affecting most electronics companies next year. But buyers offer hope, too. Because inventories are low and swings in leadtimes less volatile, next year's downturn will be mild indeed.

ELIZABETH B. BAATZ

ELECTRONIC BUSINESS leading indicator



The ELECTRONIC BUSINESS leading indicator predicts turning points in U.S. semiconductor sales with about a three- to nine-month leadtime. For more information please contact Elizabeth Baatz, senior economist, Cahners Publishing Co., 275 Washington St., Newton, Mass., 02158, or call (617) 558-4368



The ELECTRONIC BUSINESS leading indicator fell to 99.2 in July, down from 101.8 in June. Leadtimes and semiconductor bookings have taken the steepest drop in the last few months. The leading indicator is forecast to dip in the next month or two at around the 93 or 94 level.This shallow trough combined with the slow rate of decline over the past two years means the 1990 outlook for the electronics industry is for a mild, shortened downturn.

Source: Cahners Economics

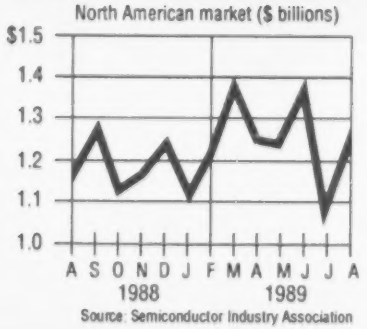
Electronics industry indicators this month

	Latest month	Previous month	Year ago	1988 average
ELECTRONIC BUSINESS leading indicator (rate-of-change, July)	99.2	101.8	108.4	107.6
U.S. semiconductor bookings ($ millions, 3-month average, Aug.)	$1,155	$1,191	$1,203	$1,178
Weekly hours of semiconductor production workers (monthly average, July)	39.0	40.0	40.0	40.2
Electronic components leadtime index (1977 = 100, Sept .)	89.1	90.7	114.2	108.9
S&P's semiconductor stock price index (1970 =10, monthly average, Aug.)	57.5	55.4	54.1	54.4
Change in electronic components inventories ($ millions, SA, July)	+$145	-$184	+$511	+$80
Contracts and orders for plant and equipment ($ billions, SA, July)	$45.7	$44.1	$40.6	$39.7

SA = seasonally adjusted, all other data is not seasonally adjusted

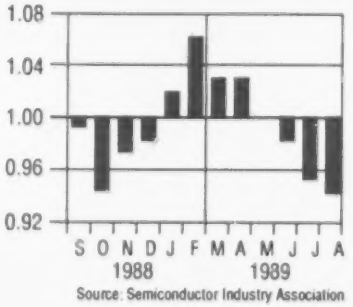
Sources: Semiconductor Industry Association, U.S. Bureau of Labor Statistics, *Electronics Purchasing* magazine, Standard & Poor's, U.S. Commerce Department, U.S. Bureau of Economic Analysis

Semiconductor sales



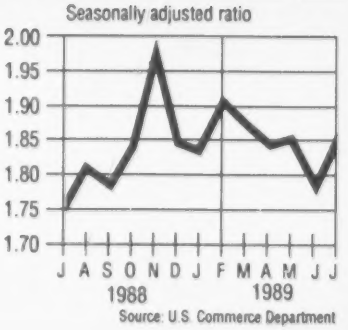
Source: Semiconductor Industry Association

Semiconductor book-to-bill ratio



Source: Semiconductor Industry Association

Component inventory-to-shipments



Source: U.S. Commerce Department